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# DUST MEASUREMENT AND CONTROL IN CONVEYOR ROADWAYS: 1. PROPOSAL FOR A RESEARCH PROGRAM AS A BASIS FOR DISCUSSION

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# DUST MEASUREMENT AND CONTROL IN CONVEYOR ROADWAYS: 1. PROPOSAL FOR A RESEARCH PROGRAM AS A BASIS FOR DISCUSSION

by

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## ABSTRACT

This paper discusses the possible airborne dust generation factors: fine dust present, fresh breakage, free fall, wind velocity; and the mechanisms which could be used in control, water application, chutes, hoods and extraction ventilation. The measurement techniques and selection of an experimental site are also discussed.

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# MESURE ET CONTRÔLE DES POUSSIÈRES DANS LES VOIES DE CONVOYEUR

## 1. PROPOSITION D'UN PROGRAMME DE RECHERCHE COMME POINT DE DÉPART POUR LES DISCUSSIONS

par

G. Knight*

## RÉSUMÉ

Le présent article examine les différents facteurs qui peuvent déterminer la production de poussières atmosphériques: les fines présentes, la fracturation en cours de transport, la chute libre, la vitesse du vent; ainsi que les mécanismes qui pourraient servir à la lutte contre les poussières: l'application d'eau, les chutes, les hottes et les ventilateurs de tirage. L'auteur examine aussi les techniques de mesure et le choix d'un lieu d'expériences.

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## INTRODUCTION

The potash mines generally handle their material dry and the relatively few men working in the extensive conveyor transport system are sometimes exposed to imprudently high dust levels. The dust exposure from the high dust levels generated in the actual cutting operation can be, and usually is, controlled by carrying the dust away from the operators using appropriate ventilation direction control. Dust generation, dispersion and control has been discussed in a previous report (1).

## DUST DISPERSION

Dust dispersion into the air in conveyor roadways can be considered as having sources, which in order of probable importance are: transfer stations, return pulleys and belt face contact, load pulleys and belt back contact, and from the transported ore on the top belt.

The factors affecting dust dispersion at the transfer point can be expected to be:

1. amount of fine dust in transported ore;
2. free fall in that it both generates fresh dust and increases the energy available to mix dust with air;
3. wind velocity over the falling material.

On the return pulleys the face side of the belt, if not clean, strikes the pulleys sufficiently violently to break dust and disperse it into the air. The same may also occur with the back side of the belt.

Dust may be dispersed into the air by jiggling of the ore as the loaded belt flexes when it passes over the pulleys, and with high air velocities.

## CONTROL METHODS

In many mines the major control method is the addition of water to bind the fine potentially airborne dust to the coarser lumps. There are problems in applying this to the partly soluble potash ore because it may lead to leaching loss, caking, and increased dust emissions from return pulleys. It is probable that any use of water would have to be closely controlled, with water feeds responding to both belt load and speed. Experiments on water feeds would have to be conducted at a transfer point where substantial dilution of treated ore would occur to avoid subsequent problems in hoisting and milling. The possible problems due to caking and leaching would need consideration. Dust control by water addition will probably be difficult to achieve and the likely occasional overfeeding of water could lead to substantial downtime.

The amount of potentially airborne dust in the ore decreases with the top size of the lumps as mined, as shown in Table 1. With the type of machines used the lump size increases with increased penetration and distance between bits. While there may be some potential for improvement, it is outside the scope of this study. However, it may be possible to determine the effect on dust dispersion if two substantially different ore sizes can be produced. Free fall is probably one of the most substantial effects in that it both creates fresh potentially airborne dust and the proportion of dust dispersed increases at larger falls. Free fall should be minimized and can be greatly reduced by chutes, especially when changes of direction are required. The major problem with chutes is clogging which is not likely to occur with dry material. Wear and replacement is also an expense.

Enclosure of transfer points is also effective in reducing dust dispersion and becomes most effective if combined with air extraction and filtration or direct passing to the return airway.

Table 1 - Estimated potential airborne dust from breaking massive rock to various sizes

| Maximum size of Broken Rock (metres) | Potential Airborne Dust in Respirable Size Range (1) (g/tonne) |
|---|---|
| 1 | 19 |
| 0.75 | 23 |
| 0.5 | 31 |
| 0.25 | 50 |
| 0.1 | 105 |
| 0.05 | 290 |
| 0.01 (1/2 in.) | 600 |

(1) The permissible dust concentration in air is of the order of 1 g/($m^3$ x $10^3$).

It is not expected that dust dispersion from the belts other than at the transfer points will be significant, however this needs confirmation by measurement.

## MEASUREMENT TECHNIQUES

Because of the dry handling potash mine dust is characteristically coarser in size distribution than at most other mines. Additionally, because of its solubility, the total intake into the exposed worker needs to be considered as well as the portion entering and retained in the alveolar region of the lungs. The dust potentially capable of entering the nose is called the inspirable fraction. The nasal entry has some size selectivity and an inspirable dust sampler should be used (2). Because the subsequent health effects can be very different and because dust control efficiencies can be different the respirable dust should also be measured.

One objective in the contract already out (3) is to compare the performance of respirable size selectors in the coarse potash mine dust, and a specific recommendation cannot yet be made. The only inspirable sampler yet designed and published should be used (4).

## CHOICE OF SITE

The site chosen should have one transfer point (or two close together) with lengths of straight roadway at least 20 times the height or width. Fifty times would be preferred in the air entering and leaving to ensure full mixing. The ore source should be constant, i.e., no change in mining machine, and the operation should have some flexibility to enable dust samplers to be set up and run while a measured quantity of ore passes and during the subsequent decay period.

A belt weigher and surveyed air measurement stations are very desirable

to enable more accurate calculation of dust dispersion and comparison of control techniques over the necessarily extended period of the testing program.

## PRELIMINARY OUTLINE OF EXPERIMENTS

1. Some with existing conditions to set up techniques and determine variability.
2. Preliminary experiment with water, about 5 Litres per tonne addition rate sprayed on 15 m before transfer point.
3. Effect of changing air velocity, dust to be measured at various positions along roadways as well as both sides of belt. The velocity range of 0.5 to 5 m/sec could be expected to determine an optimum ventilation rate for compromise between dust dilution and increased dust dispersion.
4. Effect of enclosure - temporary construction with possibly, wood, polythene sheeting and scrap belt.
5. Examine the effect of extraction on the above enclosure using a fan and ducting to draw air past the downwind dust sampling station. The dust in the air duct should also be measured.
6. If suitable sites can be found two effects could be examined:
   a) dust generation in a length of straight conveyor roadway with a transfer point, i.e., in clean air;
   b) dust decay by settlement, etc., along a return airway with no dust sources.

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4. Ogden, T.L., and Birkett, J.L., "An inhalable dust sampler for measuring the hazard from total airborne particulate"; Ann Occup Hyg 21, p 41-50; 1978.